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FR 002564850 A IT 001201236 B

(58) Field of search
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INT CL[5] C10B, F23G
Online databases: WPI; CLAIMS

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(54) Mobile biomass converter for charcoal production

(57) An apparatus for the combustion of plant materials, such as wood, sawdust, straw and bracken, to produce primarily charcoal comprises a mobile kiln mounted on skids or wheels facilitating its movement alongside a pile of plant material for combustion. In use the biomass converter is moved near to a source of plant material, the material is loaded into the converter, ignited and combusted. Charcoal is produced continuously by repeatedly filling the converter and removing products from it in a continuous combustion process.

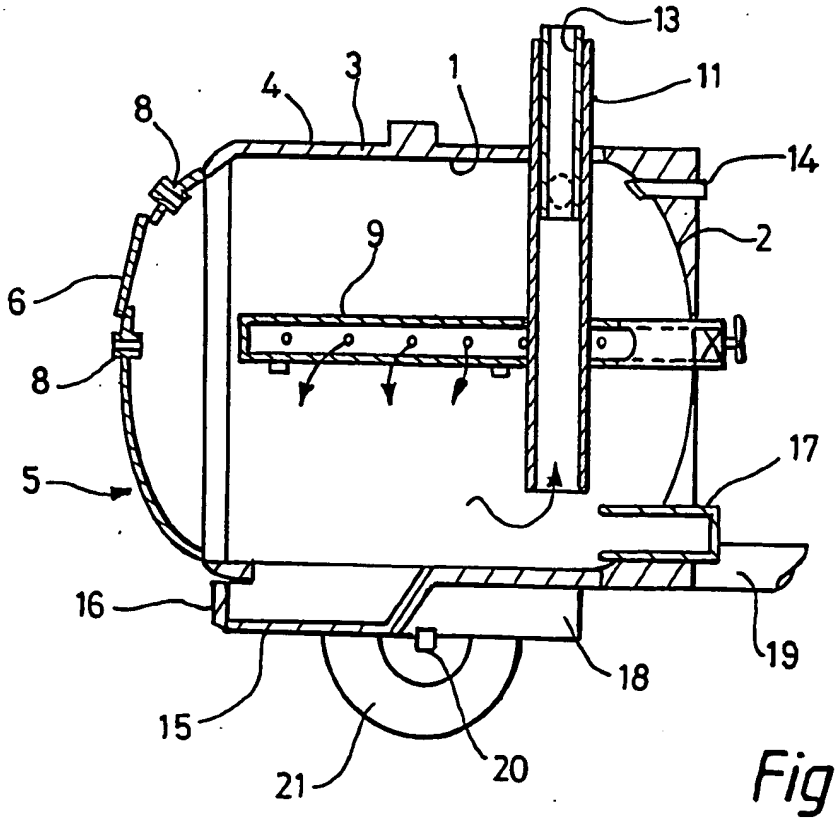

Fig 3

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were fi[illegible] 1990

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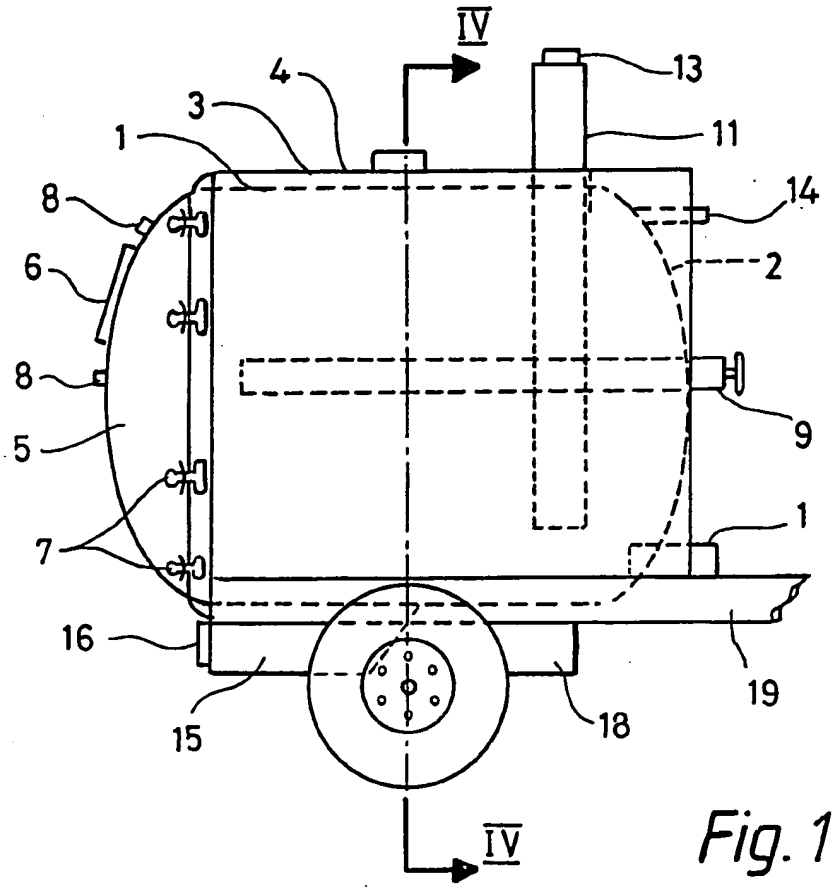

Fig. 1

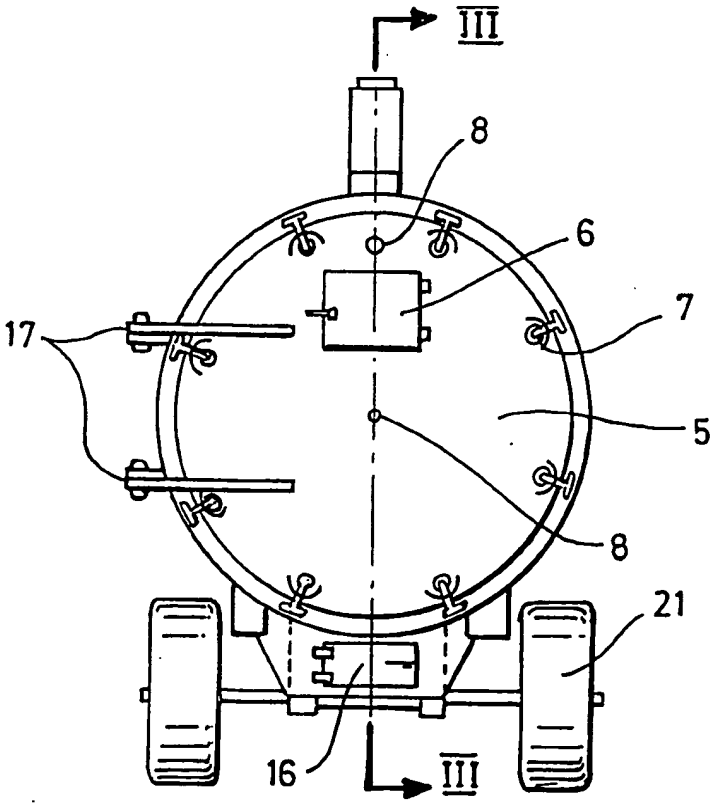

Fig. 2

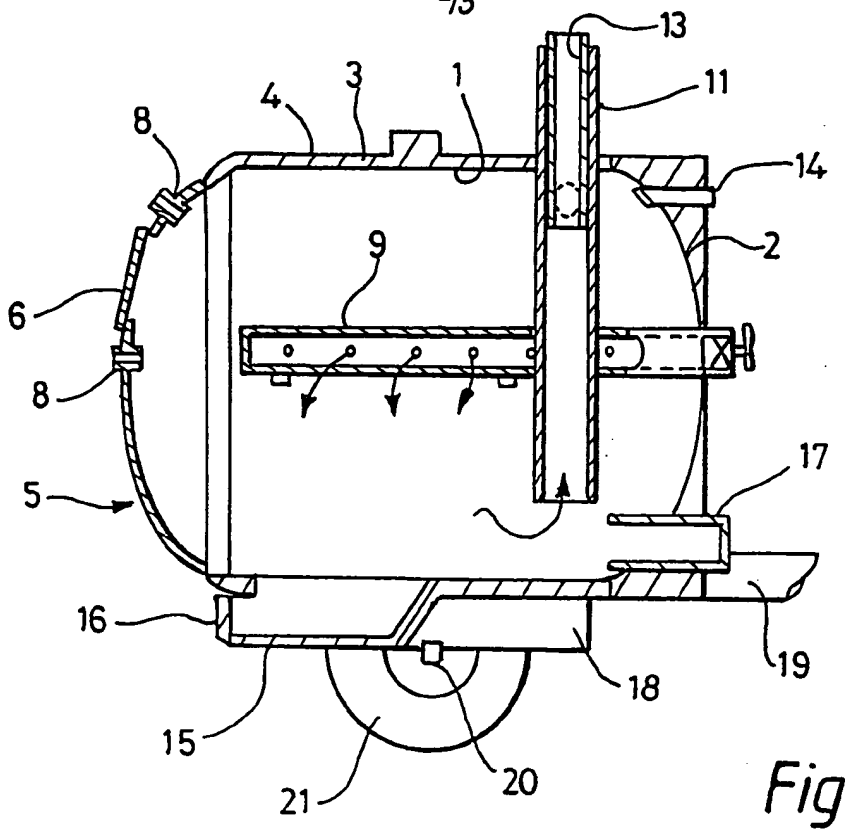

Fig 3

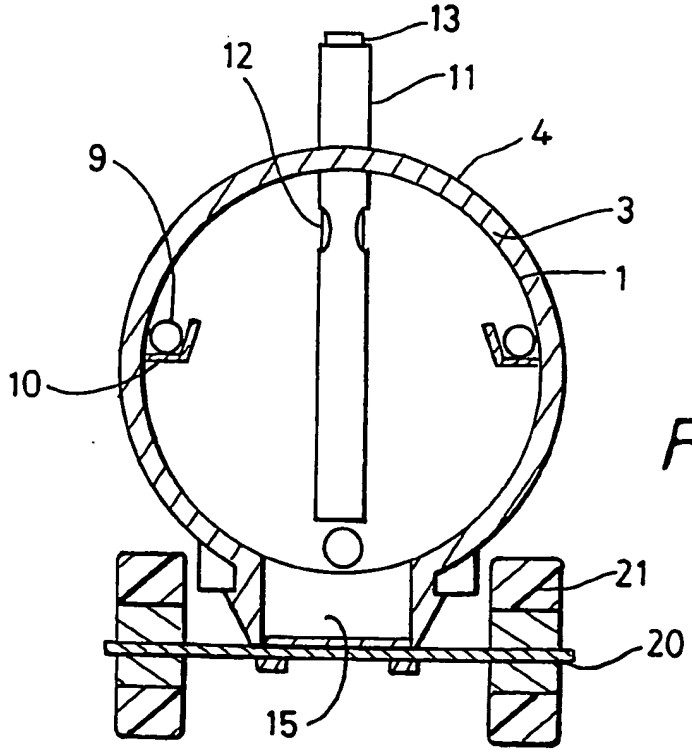

Fig. 4

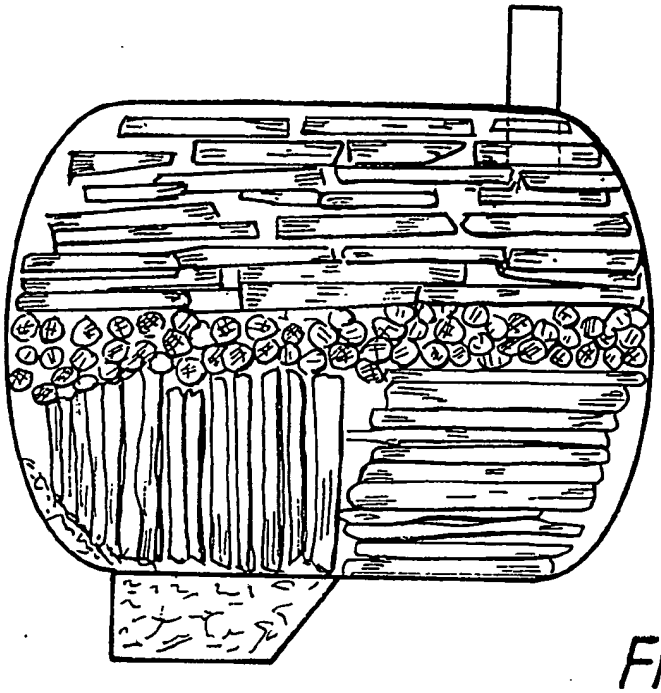

Fig. 5

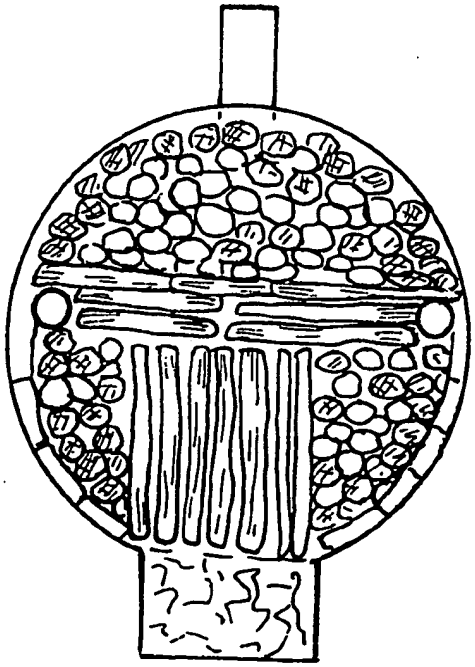

Fig. 6

IMPROVED BIOMASS CONVERTER

Field of the Invention

The present invention relates to a biomass converter for smothered combustion of plant material such as, for example, wood, sawdust, straw and bracken.

Background to the Invention

Charcoal manufacture is a process which has been used by man for thousands of years. In the process bulky plant materials are ignited and burnt under controlled conditions to drive off water and other volatile components of the material, reducing the material to a range of potentially valuable products including charcoal, various oils and tars and various gases. The product charcoal is greatly valued as an extremely versatile, easy to use fuel and has many other applications.

Modern large-scale charcoal production can be a technically complex process involving installations comprising a multiplicity of kilns and associated inter-connected drying facilities, the kilns all being under close temperature control to maximise energetic efficiency and hence economy of the manufacturing process.

One factor of the economy of the charcoal manufacturing process which is not optimised by the known charcoal manufacturing installations is the cost of handling and transportation of the raw materials and product materials. Furthermore, to the best of the

applicants knowledge, all known installations are designed to operate on a batch processing basis.

It is a general objective of the present invention to provide a highly efficient method and means for manufacturing charcoal while minimising transportation and handling costs.

Summary of the Invention

According to a first aspect of the present invention there is provided a biomass converter for smothered combustion of plant material, said converter comprising a mobile kiln mounted on skids or other means facilitating its movement along side a pile of plant material for combustion, in use.

Conveniently the mobile kiln may be mounted on a pair of wheels having an axle there-between.

Preferably the mobile kiln is provided with a large door for initial filling of the kiln and a smaller access hatch for feeding further plant material in to the kiln once combustion is underway.

Preferably a further access hatch is provided for removal of charcoal from near the base of the kiln when combustion is underway.

Preferably a depression is provided in the base of the kiln to act as a sump for the charcoal.

Where an access hatch is provided specifically for removal of charcoal, this is suitably positioned adjacent the depression.

Preferably the kiln is aerated by one or more pipes extending the length of the kiln and having a multiplicity of radial apertures spaced along the length thereof.

Preferably valve means are provided for controlling flow of air through each aeration pipe.

According to a second aspect of the present invention there is provided a method for producing charcoal, which method comprises the steps of:

providing a biomass converter according to the first aspect of the present invention;

moving the biomass converter into proximity with the source of the plant material;

loading the plant material into the kiln of the biomass converter; and

igniting and combusting the plant material within the kiln under controlled conditions to form charcoal.

Preferably the method of producing charcoal is carried out in a continuous manner, the biomass converter being moved alongside the source of plant material and repeatedly loaded with plant material from successive zones of the source without interrupting the combustion process within the kiln.

Preferably the charcoal and/or other products of the smothered combustion process within the biomass converter are intermittently removed from the kiln as the process proceeds.

Brief Description of the Drawings

A preferred embodiment of the present invention will now be more particularly described, by way of example only, with reference to the accompanying drawings wherein:

Figure 1 is a side elevation view of a biomass converter embodying the present invention;

Figure 2 is an end elevation view of the biomass converter of figure 1;

Figure 3 is a longitudinal sectional view of the biomass converter of figure 1 taken along the line III-III in figure 2;

Figure 4 is a transverse sectional view of the biomass converter of figure 1 taken along the line IV-IV in figure 1;

Figure 5 is a view similar to that of figure 3, illustrating a preferred arrangement of stacking of wooden logs within the biomass converter;

Figure 6 is transverse sectional view of the stacking arrangement illustrated in figure 5.

Description of the Preferred Embodiment

The mobile biomass converter illustrated in figures 1 to 4 comprises a substantially cylindrical kiln of two layers of metal separated by a layer of insulation. The inner cylindrical layer, or vessel, 1 is suitably constructed of steel and permanently closed at one end by a gas-tight welded domed wall 2. The insulated layer 3 which surrounds the inner layer, or vessel, 1 may be formed of any suitable heat-insulative lagging material which will be self-evident to those skilled in the art. The insulative layer 3 is encased within an outer layer of metal 4.

The open end of the vessel 1 is sealed, in use, by a large domed steel door 5 hinged to the outer layer, or casing, 4 by hinges 17. The door 5 is locked shut during use of the kiln by means of an array of clamps 7 spaced around the circumference of the door 5. A heat-resistant sealing member is incorporated in to the

periphery of the casing 4 to provide a gas-tight seal with the door 5 when the door 5 is shut.

A small access hatch 6 is provided in an upper region of the door 5 to enable fuel/biomass to be charged in to the kiln when the door 5 is closed. The hatch 6 is hinged to the door 5 and when closed seats against a gas-tight sealing member and is locked shut by clamps on the exterior of the door 5.

Further features of the door 5 are the provision of small sealable access ports 8 above and below the hatch 6. The ports 8 provide a means for inserting temperature gauges, probes and thermostats in to the kiln to facilitate regulation of the temperature within the kiln, in use.

The temperature of the kiln, in use, as monitored by the thermometers or thermostats projecting in to the interior of the kiln, is controllable by means of valve-controlled aeration pipes 9 projecting into the interior of the kiln from the permanently closed end 2 of the kiln and extending towards the door-end of the kiln.

A pair of the aeration pipes 9 are provided, one extending along each side of the kiln lying horizontally, above the centre line of the inner chamber 1. The aeration pipes 9 are supported by brackets 10 which hold the pipes 9 sufficiently far from the inner chamber wall 1 to facilitate air flow. Each of the pipes 9 is blanked-off at its remote end within the inner chamber 1 of the kiln. A succession of holes are drilled in the walls of the pipes 9 to form nozzles by which air escapes from the pipes 9 into the inner chamber 1 of the kiln. These nozzles are of such size and number that their total area is less than the cross-sectional area of the pipes 9.

The ends of the pipes 9 external to the kiln are fitted with control valves which may be manually or automatically operated to

vary supply of air to the kiln in response, primarily, to the monitored temperatures within the kiln.

Exhaust from the kiln is removed by a chimney 11 extending vertically into the inner chamber 1 of the kiln to a point close to the floor of the kiln, spaced from the floor of the kiln by a distance of approximately equal to the diameter of the chimney 11. This arrangement enables smoke to be drawn from the lower regions of the kiln.

Further provision is made for enabling smoke to be drawn from the upper regions of the kiln via lateral ports 12 in the upper, in use, regions of the chimney 11. A pair of radially opposing lateral ports 12 are provided, each having an area approximately equal to the cross-sectional area of the chimney 11. Exit of gases from the kiln through these lateral ports 12 is controlled by a concentric inner sleeve 13, slidable longitudinally relative to the chimney 11 to cover or uncover the lateral ports 12, as required.

When the lateral ports 12 of the chimney 11 are closed by the sleeve 13 and smoke can, therefore, only enter the chimney from its lower-most end, light gases such as hydrogen and carbon monoxide will collect in the upper region of the kiln inner chamber 1. These gases which are noxious but potentially valuable as fuel can be bled off via a sealable outlet pipe 14 extending through the closed end 2 of the kiln.

Provision is made for removal of the charcoal, coke and other solid products of the smothered combustion process within the inner chamber 1 of the kiln by access ports independent from the door 5 and hatch 6. A recess 15 is formed in the floor of the kiln to act as a "sump" into which the product charcoal sediments. A sealed hinged hatch 16 provides access to the charcoal accumulating in the recess, or sump, 15. This access route by which charcoal may be removed facilitates operation of the kiln in

a continuous fashion in contrast to the batch-operated manner of charcoal production in conventional kilns.

De-coking of the kiln is facilitated by a pipe 17 extending through the closed end 2 of the kiln into the interior of the inner chamber 1. This pipe 17 has an air-tight end cap which may be removed to allow access to maintenance tools for de-coking and rodding-out of the kiln, and for various other purposes.

The kiln, as described hereinabove is fixed to a chassis 18 having a towing hitch 19. In turn, the chassis 18 is mounted on an axle 20 having a tyred wheel 21 at each end thereof. The chassis 18 can to advantage be designed to extend forwardly from the closed front end 2 of the kiln to provide a platform for storage of gas cleaning and cooling equipment, an engine, a winch, power take-off equipment or other associated equipment.

An array of telescopic stabilisers (not shown) are fitted to the chassis to support the kiln against pivotal movement about the axle 20, particularly during loading of the kiln with raw material.

Operation of the biomass converter will now be described in detail. The first step of the operation is to move the biomass converter into proximity with the source of raw material. Exploiting the high mobility of the biomass converter of the present invention, the converter may be towed into the vicinity of the natural source of the plant material. Where timber is the raw material to be burned, for example, the converter , may be advanced into the heart of a wood where the timber is strewn along the ground.

To load the timber into the kiln of the converter, the door 5 is opened wide and logs of approximately a metre in length and four inches in diameter are stacked within the inner chamber 1 of the kiln in a substantially symmetrical arrangement similar to that illustrated in figures 5 and 6. The size of log and arrangement of stacking employed may be varied as appropriate but has been

found to work well in the manner described. The illustrated stacking arrangement facilitates air flow during the initial "choke" stage of the combustion process. Throughout the loading procedure the kiln may be stabilised by extension of the telescopic stabiliser legs.

Once the inner chamber 1 of the kiln is fully loaded, the door 5 is closed and clamped securely by the clamps 7. The cavity created within the chamber 1 by the domed recess of the door 5 may them be filled by insertion of further logs through the hatch 6 in the door 5.

The inner sleeve 10 within the chimney 11 is raised to expose the lateral openings in the chimney 11 and is later slowly lowered as the temperature in the kiln rises. Hatches 6 and 16 and aeration pipes 9 are fully opened to optimise air flow through the kiln during the initial "choke" phase of combustion.

The charge within the kiln is then ignited near the chimney and, when smoke is observed emerging from hatch 6 or when flames are observed near the opening of hatch 6, hatch 6 is closed. When smoke is observed emerging from the aeration pipes 9 they too are closed. Closure of hatch 16 follows when glowing embers are seen in the sump 15.

The initial, or choke, phase of the combustion process is judged to be completed when the smoke emerging from the chimney changes from white to a blue hue.

If the kiln has been idle for a protracted period of time a slightly different choke procedure may be employed, as follows. With the chimney 11 open, a fire is lit on a bed of charcoal near the chimney 11. The hatch 6 may be left open until a satisfactorily glowing bed of embers can be seen. The hatch 6 is then closed and both the aeration pipes 9 and the hatch 16 are fully opened.

Completion of the choke phase is followed by opening of the valves of the aeration pipes 9 to cause a rise in temperature within the upper regions of the kiln inner chamber 1 to above three hundred degrees centigrade but below five hundred degrees centigrade. Temperatures in excess of five hundred degrees centigrade are to be avoided in order to maintain energetic efficiency of the process.

The combustion process may now be carried out in a continuous fashion by charging logs through the hatch 6 in the door 5. Consequent drops in temperature within the kiln may be compensated for by further opening of the aeration pipes 13 to bring the temperature back up to the operational optimum as rapidly as possible.

A blue colouration to the smoke emerging from the kiln or the appearance of haze indicates that the charge within the kiln is charred and that fresh material may usefully be added.

The hatch 16 in the sump 15 may be opened for brief periods to permit extraction of charcoal. Once removed the charcoal must be sealed in air-tight containers allowing escape of gases and steam but preventing ingress of air. Once the charcoal has cooled sufficiently to remove the risk of excessive further combustion upon exposure to air it may then be removed from the air-tight containers.

Operation of the biomass converter in a continuous fashion as described above can be combined with movement of the converter along successive zones of the source of raw material to be charged into the kiln, thereby reducing the labour necessary to transfer the logs in to the kiln. This greatly enhances speed and cost efficiency of the process.

CLAIMS

1. A biomass converter for smothered combustion of plant material, said converter comprising a mobile kiln mounted on skids or other means facilitating its movement in use along side a pile of plant material for combustion.

2. A biomass converter according to Claim 1 wherein, the mobile kiln is mounted on a pair of wheels having an axle therebetween.

3. A biomass converter according to Claim 1 wherein, the mobile kiln is provided with a large door for initial filling of the kiln and a smaller access hatch for feeding further plant material into the kiln once combustion is underway.

4. A biomass converter according to Claim 1 wherein, the mobile kiln is provided with an access hatch for removal of charcoal from near the base of the kiln when combustion is underway.

5. A biomass converter according to any of the preceding Claims wherein, a depression is provided in the base of the kiln to act as a sump for the charcoal.

6. A biomass converter according to Claims 4 and 5 wherein, the access hatch provided specifically for removal of charcoal is suitably positioned adjacent the depression.

7. A biomass converter according to any of the preceding Claims wherein, the kiln is aerated by at least one pipe extending the length of the kiln and having a multiplicity of radial apertures spaced along the length thereof.

8. A biomass converter according to Claim 7 wherein, a valve means is provided for controlling flow of air through said at least one pipe.

9. A method for producing charcoal, which method comprises the steps of:

providing a biomass converter according to the preceding Claims;

moving the biomass converter into proximity with a source of plant material;

loading the plant material into a kiln of the biomass converter; and

igniting and combusting the plant material within the kiln under controlled conditions to form charcoal.

10. A method according to Claim 9 wherein, the method of producing charcoal is carried out in a continuous manner, the biomass converter being moved alongside the source of plant material and repeatedly loaded with plant material without interrupting the combustion process within the kiln.

11. A method according to Claims 9 or 10 wherein, the plant material is provided in successive zones.

12. A method according to Claims 9, 10 or 11 wherein, the charcoal and/or other products of the smothered process are intermittently removed from the kiln as the process proceeds.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
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Relevant Technical fields

(i) UK Cl (Edition K) C5E (EAD), (EBC)

(ii) Int Cl (Edition 5) C10B; F23G

Search Examiner
M J WALKER

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI, CLAIMS

Date of Search
8 OCTOBER 1992

Documents considered relevant following a search in respect of claims 1-12

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	FR 2564850 A (SENNESAEL) see eg Claim 1	1 and 8
X	IT 1201236 B (BRUNI)	1 at least

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

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